QUALITY ASSURANCE PROJECT PLAN (QAPP)

GZA GeoEnvironmental, Inc.
One Edgewater Drive
Norwood, MA 02062

1. Title and Approval Page

Jordan Pond Restoration Study
(Project Name)

GZA GeoEnvironmental, Inc.
(Responsible Agency)

February 1, 2003
(Date)

Project Manager Signature	
Name/Date	Chad Cox
Project QA Officer Signature	
Name/Date	Igor Runge
(Client) Project Manager Signature	
Name/Date	Nancy Allen
MADEP QA Officer Signature	
Name/Date	Arthur Screpetis

2. Table of Contents

In preparing this QAPP, GZA made use of Standard Operating Procedures (SOPs) provided by the Massachusetts Watershed Watch Partnership and others. These SOPs are available on the world wide web at http://www.umass.edu/tei/mwwp/protocols.html, and by request.

3. Distribution List

Names and telephone numbers of those receiving copies of this QAPP.

i. Nancy Allen, Shrewsbury 508-841-8512

ii. Peter Baril, Chad Cox, Igor Runge, GZA GeoEnvironmental, Inc., 781-278-3700

iii. Don Schulze, GZA Laboratory Division, 781-278-4700

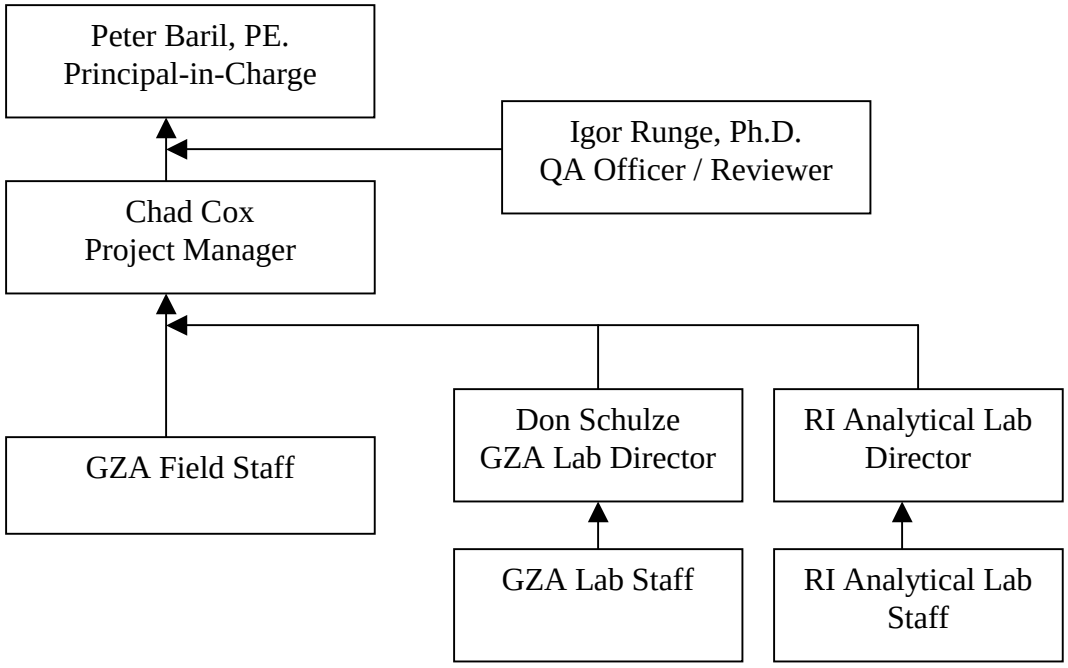
iv. Arthur Screpetis, MADEP, 508-767-2875

4. Project/Task Organization

List key project personnel and their corresponding responsibilities.

Name	Project Title/Responsibility
Allen, Baril, Cox, Runge, Screpetis	Technical Advisory Committee
Chad Cox	Project Manager, Field/Sampling Leader
Igor Runge	QA Officer
Don Schulze	Laboratory Manager/Leader

GZA Project Management Organization



5. Problem Definition/Background

A. Problem Statement

Previously, Jordan Pond had been used for swimming and recreation, but in 1998 the swimming beach was closed due to high levels of bacteria detected in the water. The source of these bacteria is currently unknown. Septic systems in the watershed have been investigated and waterfowl are also suspected. In addition to elevated levels of bacteria, the pond also experiences problems with nuisance aquatic vegetation, turbidity, and algae blooms.

B. Intended Usage of Data

The data collected in this study is intended to provide information to help design strategies for pollution reduction, aquatic vegetation and waterfowl control, and pond management, and to aid Town planners and local stakeholders in making an informed decision when evaluating the potential effectiveness of strategies to improve the quality of Jordan Pond.

6. Project/Task Description

A. General Overview of Project

This study is to include a review of existing information, bathymetric mapping, sediment mapping, surface water, stormwater, and sediment sampling to characterize the nutrient and bacteria loading to the pond, a biological survey, waterfowl control recommendations, a review of potential archeological issues related to dredging, and recommendations on increasing flow through the pond. This study will result in a Pond Management Plan and a Preferred Alternative Feasibility Assessment.

B. Project Timetable

Activity	Projected Start Date	Anticipated Date of Completion
Prepare and Submit QAPP	September 1, 2002	November 15, 2002
Sample & Testing	September 26, 2002	October 16, 2002
Data Quality Control	September 26, 2002	October 23, 2002
Prepare Report	December 1, 2002	February1, 2003

7. Measurement Quality Objectives

A. Data Precision, Accuracy, Measurement Range

Matrix	Parameter	Measurement Range	Accuracy	Precision
Fresh Surface Water	DO	0.0-15.0 mg/l	+0.5 for zero standard	<0.5 difference between dups
Fresh Surface Water	BOD	0.0-10.0 mg/l	Within lab control limits for glucose-glutamic acid and dilution water blank checks	<1.0 difference between dups
Fresh Surface Water	Temperature	0.0-30.0 ºC	±0.5 °C in comparison to ice water	+/- 0.5 °C
Fresh Surface Water	Conductivity	10-2000 µS/cm	±5% of known QC std.	10% RPD
Fresh Surface Water	pH	4.0-10.0 pH units	± 0.2 of QC standard	± 0.2
Fresh Surface Water	TP (water)	0.000-0.500 mg/l	80-120 % recovery for QC std. and lab fortified matrix	± 0.005 mg/l if less than 0.050 mg/l or 20% RPD if more than 0.050 mg/l
Fresh Surface Water	Dissolved P	0.00-2.00 mg/l	80-120 % recovery for QC std. and lab fortified matrix	± 0.005 mg/l if less than 0.050 mg/l or 20% RPD if more than 0.050 mg/l
Fresh Surface Water	Secchi disk Transparency	0.0-10.0 m	NA	± 0.2 m for duplicate readings by the same monitor, as well as different monitors.
Fresh Surface Water	Turbidity	0-200 NTU	90-110% recovery of turbidity std.	± 5 NTU if less than 1 NTU or 20% RPD if more than 1 NTU
Fresh Surface Water	Ammonia Nitrogen	0.00-1.0 mg/l N	80-120 % recovery for QC std. and lab fortified matrix	± 0.01 if less than 0.1 mg/l or 20% RPD if more than 0.1 mg/l
Fresh Surface Water	Nitrate Nitrogen	0.00-2.0 mg/l N	80-120 % recovery for QC std. and lab fortified matrix	± 0.02 if less than 0.1 mg/l or 20% RPD if more than 0.1 mg/l
Fresh Surface Water	Kjeldahl Nitrogen	0.00-2.0 mg/l N	80-120 % recovery for QC std. and lab fortified matrix	± 0.20 if less than 0.5 mg/l or 20% RPD if more than 0.5 mg/l
Fresh Surface Water	Fecal Coliform, Enterococcus, E-coli, Fecal Streptococcus	0-100,000 colonies / 100 ml	TNTC on positive control and 0 or less than reporting limit for negative control	30% RPD for log 10 transformed duplicate data

B. Data Representativeness

Data collected during this project will be considered representative of conditions within the Pond during the specific sampling dates. Sampling rounds during conditions of stratification will collect samples from both the epilimnion and hypolimnion.

C. Data Comparability

Standard equipment, sampling procedures, and testing methods will be used. All procedures will be uniform at each site and during each sampling round.

D. Data Completeness

Parameter	**No. Valid Samples Anticipated**	**No. Valid Samples Collected & Analyzed**	**Percent Complete**
DO	5	5	100
BOD	2	2	100
Temperature	5	5	100
Conductivity	5	5	100
pH	5	5	100
TP (water)	7	7	100
Dissolved P	4	4	
Secchi disk Transparency	3	3	100
Turbidity	7	7	100
Ammonia Nitrogen	4	4	100
Nitrate Nitrogen	5	5	100
Kjeldahl Nitrogen	4	4	100
Fecal Coliform, Enterococcus, E-coli, Fecal Streptococcus	14	14	100

8. Training Requirements and Certification

A. Training Logistical Arrangements

Type of Required Training	Frequency of Training/Certification
internal field and laboratory training	ongoing

C. Description of Training and Trainer Qualifications

N/A

9. Documentation and Records

A. Field data sheets: Standard Field Data Sheets will be completed on-site at the time of sampling. At a minimum the field data sheets will include the following information: Waterbody, Site Name and/or Number, Time, Date, Field Personnel Names, Weather Conditions, Air and Water Temperature, Sampling Parameters Tested or Sampled for, and GZA Job Number.

B. Sample labeling: All Sample bottles shall be labeled with adhesive labels placed on the bottle (NOT the cap). At a minimum, the label shall state the following information: Site Name and/or Number, Date, Field Personnel Names, Sampling Parameters to be Tested, and GZA Job Number

C. Chain of custody forms: (see Appendix E) Forms are signed by collectors as they relinquish the sample to the drop-off site. Sample ID number, Date, Time, and Signature of Sample Relinquishers are filled on the Chain of Custody Form.

D. Lab data sheets (including inspection and calibration logs): (see Appendix F) Include date and time of sample analysis. Also on the lab data sheet is the name of the analyst and the internal QC procedures followed. These lab data sheets are copied and the originals sent to the project coordinator.

10. Sampling Process Design

A. Rationale for Selection of Sampling Sites

Sampling sites were selected as follows:

- One site representative of water quality conditions in the beach area
- One site representative of water quality conditions in the epilimnion and hypolimnion at the presumed deepest point in the Pond
- Two primary stormwater discharge locations
- Additional sites for water quality profiles as needed for observing spatial variability within the Pond

B. Sample Design Logistics

	Type of Sample/ Parameter	**Number of Samples**	**Sampling Frequency**	**Sampling Period**
Biological	FC	5	N/A	9/26, 10/16/02
	FS	5	N/A	9/26, 10/16/02
	E.coli	2	N/A	9/26, 10/16/02
	Enterococcus	2	N/A	9/26, 10/16/02

	Type of Sample/ Parameter	**Number of Samples**	**Sampling Frequency**	**Sampling Period**
Physical	DO	5	N/A	9/26, 10/16/02
	BOD	2	N/A	9/26, 10/16/02
	Secchi depth	3	N/A	9/26, 10/16/02
	Turbidity	7	N/A	9/26, 10/16/02
	Temperature	5	N/A	9/26, 10/16/02

	Type of Sample/ Parameter	Number of Samples	Sampling Frequency	Sampling Period
Chemical	Total Phos.	7	N/A	9/26, 10/16/02
	Dissolved Phos.	4	N/A	9/26, 10/16/02
	Ammonia Nitr.	4	N/A	9/26, 10/16/02
	Nitrate Nitrogen	5	N/A	9/26, 10/16/02
	TKN	4	N/A	9/26, 10/16/02
	pH	5	N/A	9/26, 10/16/02
	Conductivity	5	N/A	9/26, 10/16/02

C. Site Safety Plans

Please refer to the project-specific GZA Health and Safety Plan (HASP) for site safety plans.

11. Sampling Method Requirements

Container, Sample Size, Type, Preservation and Storage for Common Water Quality Indicators (Standard Methods 20th edition, 1998)

Indicator	Container Type	Minimum Sample Quantity (ml)[2]	Sample Type[3]	Preservation	Maximum Holding Time
Fecal Coliform	Sterile P, G bottles or Whirl-Pak Plastic Bags	>100 ml	g	Refrigerate, 4°C See delayed incubation procedure 9222E in Standard Methods	Refrigerate immediately. Deliver to lab within 6 hr. Begin analysis within 2 hr. of receipt.
Alkalinity	P, G	200	g	Refrigerate, 4°C ,do not open sample bottle until analysis	14 days

BOD	P, G	2 bottles 300, 60	g, c	Refrigerate, 4°C	48 hrs
Chlorophyll	P, G	1000	g	Unfiltered, dark, 4°C	Unfiltered, fresh-24 hr;[4] Filtered, frozen-21 days;[4] Filtered, forced air-dried-15 days[5]
Specific Conductance	P, G	500	g, c	Immediately or refrigerate at 4oC, filtered with 0.45 micron filter	28 days
Ammonia	P, G	500	g, c	Refrigerate to 4°C add H_2SO_4 to pH<2 and refrigerate	48 hours 28 days
Nitrate	P, G	100	g, c	Analyze as soon as possible; refrigerate, 4oC add H_2SO_4 to pH<2 and refrigerate	48 hr 28 days
Organic, Kjeldahl	P, G	500	g, c	Add H_2SO_4 to pH<2. Refrigerate, 4oC,	28 days
Oxygen, dissolved Electrode Winkler	G, BOD bottle	300, 60	g	Analyze immediately Titration may be delayed after fixing	Analyze immediately 8 hr in the dark
pH	P, G	50	g	Analyze immediately	Analyze immediately
Phosphorus, total	P, G Acid-washed; no use of detergent permitted	100	g, c	Immediately Add H2SO4 to pH<2 and refrigerate at 4oC Freeze	48 hrs 28 days 12 months
Salinity	G, wax seal	240	g	Analyze immediately or refrigerate at 4oC	28 days
Temperature	P, G	-	g	Analyze immediately	Analyze immediately

Turbidity	P, G	100	g, c	Cool at 4oC	48 hr
Total Suspended Solids Total Residue/ Total Solids, Dissolved Solids	P, G	500	g	Immediately or refrigerate to 4oC	7 day

Parameter	Matrix	Sampling Equipment	Sampling Method
Dissolved Oxygen (lake)	Water	Modified Wisconsin Sampler w/ 60 ml BOD bottle	Sample collected 0.5 m from lake bottom and fixed on site
Dissolved Oxygen (river)	Water	BOD bottle (300 ml)	Sample collected at surface with care to avoid any bubbles and fixed on site
Total Phosphorus	Water	1 liter acid-washed polyethylene bottle	Bottle rinsed 3 times with water at site and filled at elbow depth by inserting bottle, mouth down, to depth and inverting. Sample is fixed with sulfuric acid.

12. Sample Handling and Custody Procedures

Samples are collected and labeled by the field personnel, kept in a cooler with a frozen freezer pack, and immediately brought by the collector with the data sheets to the drop-off site. The date and time of arrival to the drop-off site are recorded and signed by the collector on the Chain of Custody Form. Samples are kept in a cooler with ice until they are brought, on the same day, to the laboratory, and the Chain of Custody Form is completed when the samples are transferred to the lab. The lab copies the Chain of Custody Form and gives the original to the project coordinator. The lab discards samples after analysis.

13. Analytical Methods Requirements

Indicator	Method Source and Number	Reporting Units	Modifications or options
DO	EPA 360.1, 360.2 SM 4500-O A,B,C,G	mg/l	
BOD	EPA 405.1 SM 5210B	mg/l	
Temperature	EPA 170.1 SM 2550 B	oC	
Conductivity	EPA 120.1 SM 2510 B	µS/cm	
pH	EPA 150.1 SM 4500-H B	pH units	
TP (water)	EPA 365.2, 365.3 SM 4500-P E	mg/l	
Alkalinity	EPA 310.1 SM 2320 B	mg/l	
Color	EPA 110.1, 110.2 SM 2120	PCU	
Turbidity	EPA 180.1 SM 2130	NTU	
Salinity	SM 2520 4	SU	
Total Suspended Solids, TSS	EPA 160.3 SM 2540 B	mg/l	
Total Dissolved Solids, TDS	EPA 160.2 SM 2540 D	mg/l	
Hardness	SM 2340 C		
Chlorophyll a	SM 10200 H	µg/L	

Ammonia Nitrogen	EPA 350.2, 350.3 SM 4500-NH3	mg/l N	
Nitrate Nitrogen	EPA 353.3 SM 4500 NO3 E	mg/l N	
Kjeldahl Nitrogen	EPA 351.3 SM 4500 N	mg/l N	
Fecal Coliform, Enterococcus, E-coli	SM 9010-9040, 9222B, 9221 E, 9222D	colonies/ 100 ml	

14. Quality Control Requirements

Indicator	**Accuracy**	**Precision**
Fecal Coliform E. coli	Negative and positive plates	Field and Lab replicate analysis
Dissolved Oxygen	Use MWWP audit sample	Field and Lab replicate analysis
Turbidity	Use QC std./audit sample	Field and Lab replicate analysis
Secchi Transparency	Annual calibration check of calibrated line	Field replicates by different observers
Temperature	Compare to ice water	Field replicate observations by different observers
pH	Use MWWP or commercial audit samples	Field and Lab replicates
Total Alkalinity	Use MWWP or commercial audit samples, blanks, standards	Field and Lab replicates
Conductivity	Field blanks	Field and Lab replicates
Total Phosphorus	Use commercial audit samples including dilutions to MA relevant levels Spiked sample recovery Field blanks	Field and Lab replicates

Nitrogen -Total Kjeldahl	Use commercial audit samples including dilutions to MA relevant levels Spiked sample recovery Field blanks	Field and Lab replicates
Nitrogen - Nitrate	Use commercial audit samples including dilutions to MA relevant levels Spiked sample recovery Field blanks	Field and Lab replicates
Nitrate - Ammonia	Use commercial audit samples including dilutions to MA relevant levels Spiked sample recovery Field blanks	Field and Lab replicates
Biological Oxygen Demand	Use commercial check standard or use the glucose & glutamic acid solution described in Standard Methods, 20th ed., method 5210 B.	Field replicates
Chlorophyll a	Partial accuracy check using commercial audit samples	Field and Lab replicates
Total & Total Dissolved Solids	N/A	Replicates
Macrophyte taxa	Expert verification	Replicates
Macrophyte distribution	N/A	Limited area replicate observations by different observers
Macrophyte % cover	N/A	Limited area replicate observations by different observers
Macroinvertebrate taxa	Expert verification	Replicates
Macroinvertebrate abundance	N/A	Replicates

Habitat	N/A	Replicates

Indicator(s)	Accuracy Checks	Precision Checks	% Quality Control Samples
Temperature	Compare to ice water	Field replicate observations by different observers	10%
Dissolved Oxygen	MWWP Audit Sample	Field and Lab replicate analysis	10%
Benthic Macroinvertebrates	Taxonomic verification.	3 Replicates at each site	All

Field/ Laboratory/ Data Analysis QC Checks

Field QC checks include equipment blanks and duplicate analyses. Laboratory QC checks include method blank results, replicate sample results, and matrix spike results. Data analysis QC checks include Project Manager review.

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15. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Equipment Type	Inspection Frequency	Type of Inspection
Wisconsin Sampler	Before each sampling date	No leaks Proper operation of trip mechanism
Secchi Disk	Before each sampling date	Visual
Calibrated Line	Before each sampling date	Integrity of line and clips
D.O. Meter	Before each sampling date	Battery life, electrical connections, membrane condition
Thermistor	Before each sampling date	Battery life
Turbidometer	Before each sampling date	Battery life

pH Meter	Before each sampling date	Battery life, level of electrolyte, integrity of probe
Digital Titrator	Before each sampling date	Proper installation of cartridge, zero reset
Conductivity Meter	Before each sampling date	Battery life

16. Instrument Calibration and Frequency

Equipment Type	Calibration Frequency	Standard or Calibration Instrument Used	Corrective Action
Calibrated Line	Annually	Tape Measure	Recalibrate or replace with calibrated line
D.O. Meter	Before each sampling period (e.g. biweekly, monthly, etc.)	Following manufacturers instructions Comparison against Winkler titration see SOP	Replace membrane or adjust instrument
Thermistor	Annually	Certified Thermometer	Replace or provide correction factor
Turbidometer	Annually Before each sampling	Formazin Standards Secondary Standards see SOP	Adjust instrument
pH Meter	Annually Before each sampling	Audit samples and certified lab meter comparison Known standards, MWWP unknown see SOP	Adjust instrument, clean electrodes, replace electrodes
Digital Titrator	Before each sampling	MWWP unknowns	Replace
Conductivity Meter	Prior to each use	Known Standards	Adjust according to manufacturer's recommendations
Spectrophoto-meter	Annually	Known Standards	Adjust according to manufacturer's

			recommendations
Balance	Annually Before each sampling	Annual certification Use of certified inspection standards before each use	Adjust and recalibrate
Thermometer	Beginning and mid way through season	Ice water	Replace or provide correction factor

Note all calibration results in instrument logbook.

17. Inspection/Acceptance Requirements

Supplies	Inspection Frequency	Type of Inspection	Available Parts	Maintenance
Reagents	Before each sampling date	Visual inspection of quantity and expiration date	Spare, fresh reagents	Annual replacement at beginning of sampling season
Field and Lab sample sheets	Before each sampling date	Visual	Additional copies	
Thermometer	Before each sampling date	Integrity of column	Spare thermometer	Calibrate and replace as needed
Waders or Life Preservers	Before each sampling date	Visual inspection for damage	Patch kit	As needed
Macroinvertebrate Nets	Before each sampling date	Visual inspection for damage and cleanness	Roll of net material, extra bags	Annually or as needed Logbook notation
Sample Bottles	Before each sampling date	Integrity, cleanness and seal for nutrient bottles, verified sterility of bacterial sample bottles, equipment or rinsate blank for reused bottles (see Glossary)	One set of spare bottles	NA
Cooler	Before each sampling date	Cleanliness, Ice packs	NA	Annually or as needed

18. Data Acquisition Requirements

Maps, GIS Layers, Previous Reports, Historical Information, Engineering Plans. (Refer to Jordan Pond Management Plan for further discussion of available data and materials).

19. Data Management

Field data sheets are inspected for completeness or problems by the project coordinator and the QC officer as soon as they are received and the collectors are contacted if any problem is suspected. Lab analysts discard data for samples that did not arrive cool. Lab analysts send their data sheets to the project coordinator and the QC officer as soon as the results are available. The data are entered in the GZA project file using appropriate software and proofed by a second person. Descriptive statistics and graphing are used to uncover any outliers or errors. Any questionable data is flagged and rechecked. The project coordinator and the QC officer work together to determine that the data meet the project requirements. Any data not meeting the project DQOs are noted. If necessary, a review of the procedures is made to determine where problems arose, and appropriate steps will be taken to correct the problem.

20. Assessment and Response Actions

As described above, review of field data sheets, lab data sheets, and QC data occurs immediately after each collection. If an error is discovered, it is corrected if possible. If no correction, or if quality control objectives are not met, the data are discarded. Raw data and tabular and graphical summaries of the data will be shared and discussed with members of the TAC.

21. Reports

Internal Memos, Draft Reports, Final Reports, Jordan Pond Management Plan

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22. Data Review, Validation, and Verification

Data will be reviewed for consistency and errors by the QC officer initially, then by the TAC.

23. Validation and Verification Methods

The following validation procedures are established throughout the project: equipment is calibrated at the start of the season and checked each collection; field blanks, field duplicates, and blind samples are submitted to the laboratory, which also performs lab duplicates and blanks; chain of custody is maintained; field sheets and data entry are checked by a second party; descriptive statistics and graphs are produced; review by the TAC occurs at the end of the sampling season.

24. Reconciliation with Data Quality Objectives

Whenever feasible, calculations and determinations for precision, completeness, and accuracy will be made. Any corrective action will be implemented, noted, and initialized by the QC officer. If data quality indicators do not meet the project's specifications, then data may be discarded. Investigation of problems will take place and corrections will be documented. If equipment failure is found to be the cause, calibration and maintenance techniques will be reassessed. Any limitations on the data will be noted.

Parameter/ units	**Corrective action planned if accuracy/precision objective not met**	**Planned Response if Completeness Objective Not Met**
Temperature ^{o}C	Give thermometers a correction factor to improve their accuracy	Train back-up samplers
Dissolved Oxygen (mg/l)	Replace reagents Retrain analysts	Train back-up volunteers Maintain greater inventory of chemicals and sample bottles
pH Standard units	Check and recalibrate meter	Provide backup pH electrode
Conductivity (µmhos/cm)	Check and recalibrate meter	Provide additional laboratory help so that holding time can be met.
Turbidity (NTU)	Check and recalibrate meter with primary standards	Have battery replacements available

25. References:

1) Massachusetts Department of Environmental Protection. (Paul J. Godfrey).
The Massachusetts Volunteer Monitor's Guidebook to Quality Assurance Project Plans.
October 1, 2001.

2) American Water Works Association 20th ed., 1998.
Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Water Pollution Control Federation, Washington, DC.

3) Deerfield River Watershed Association. (Marie Françoise-Walk).
Quality Assurance Project Plan for the Deerfield River Monitoring Program (Draft).
Prepared for the Commonwealth of Massachusetts Executive Office of Environmental Affairs (EOEA). April 14, 1999.

4) Environmental Protection Agency (EPA), 1999.
Methods and Guidance for Analysis of Water.
Office of Water, EPA 821-C-99-004.

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